

Tailorable Porous Ceramics via Freeze Casting

Completed Technology Project (2011 - 2015)



Project Introduction

Freeze casting of ceramics is a novel technique used to produce porous materials. The process involves solidifying a solvent in a ceramic slurry to produce a frozen network, subliming the frozen solvent, and sintering the remaining porous powder network. Applications for porous ceramics include filters, catalysts, high temperature insulation, and electrodes for energy devices. Yet the pore network, structure and morphology required for each of these applications vary widely. Although recent studies have explored how processing parameters affect pore fraction, size and shape, less attention has been paid to the internal structure and connectivity of the network, both critical components in porous materials performance. The goal of the proposed research is to develop a fundamental understanding of the freeze-casting process sufficient to establish pore structure-property relationships. Aluminum oxide in slurries made with water and camphene will be used as control materials for the study but other energy-related ceramics of interest to NASA will be included to validate the findings. Characteristics of a pore network include percent porosity, connectivity of pores, pore shape, size and size distribution, specific surface area, and tortuosity. These will be determined using two- and three-dimensional imaging coupled with porosimetry and surface area measurements. An important outcome of the research will be a model which relates processing parameters to the characteristics of the resulting pore network. This model will enable the fabrication of porous ceramics with specific pore network properties for desired applications.

Anticipated Benefits

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Project Image Tailorable Porous Ceramics via Freeze Casting

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

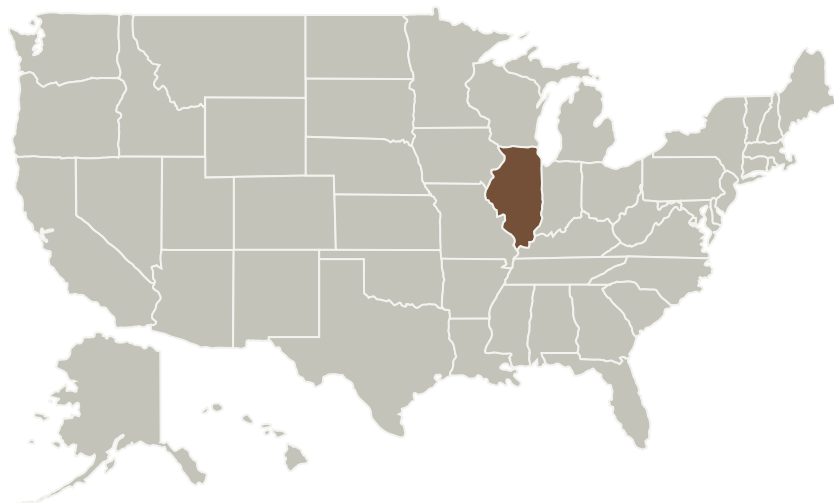
Space Technology Research Grants

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Northeastern University (NEU)	Supporting Organization	Academia	Boston, Massachusetts

Primary U.S. Work Locations

Illinois

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

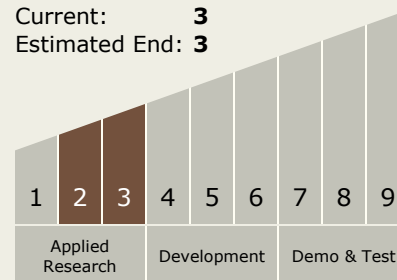
Katherine Faber

Co-Investigator:

Sarah M Miller

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.4 Manufacturing
 - └ TX12.4.1 Manufacturing Processes

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Images



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Project Image Tailorable Porous
Ceramics via Freeze Casting
(<https://techport.nasa.gov/image/1832>)

Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>